# PNEUMATIC SHOOTING DEVICE

## BACKGROUND OF THE INVENTION

**1. Field of the invention.**

The present invention relates to a pneumatic shooting device, and, more particularly, to an action in a pneumatic shooting device.

**2. Description of the related art.**

Pneumatic shooting devices are known which are used as a non-lethal deterrent in law enforcement, as a simulated weapon in war games and as a marking device in paintball competitions. A known pneumatic shooting device includes a trigger actuated, spring loaded bolt that, when actuated by pulling the trigger, strikes a pneumatic valve. The striking action of the bolt opens the valve releasing a pressurized gas behind a projectile which propels the projectile through a barrel. A blowback from the valve returns the bolt to a firing position and also results in less pressure for propelling the projectile. Multiple moving parts, such as both the bolt and the valve, increases the chance for device failure.

As applications for pneumatic shooting devices have increased due to their utility and wide spread use, a need for pneumatic shooting devices which fire larger projectiles has developed. Larger projectiles require larger firing pressures. The aforementioned pneumatic shooting devices are not suitable for these larger projectiles primarily because their valve, receiver, barrel and other elements are not suitable for the larger firing pressures. In other words, the aforementioned pneumatic shooting devices are not scalable to larger pressures required by larger projectiles.

In paintball competitions, a known application of larger projectile pneumatic shooting devices are in devices referred to as "scenario launchers". Such a scenario launcher is used to

fire a rocket, for example, and a judge determines the "kill zone" depending on the point of impact of the projectile, the terrain and the type of projectile fired.

One known scenario launcher incorporates a rupture disk. The rupture disk ruptures at a predetermined pressure allowing pressurized gas to escape to propel the projectile. Such devices have a time delay between triggering and firing. This delay occurs as the pressure increases to rupture the disk. The delay may be as long as one or more seconds. The shooter, during the delay, is unsure of when or if the device will fire. Further, the shooter or target can move during the delay resulting in loss of accuracy. Another disadvantage is that the rupture disk needs to be replaced after every firing.

Another known pneumatic shooting device uses a ball valve to release the pressurized gas which propels the projectile. While the initial release of pressure is relatively quick compared to the rupture disk method, the release of pressure is gradual, as in turning on a faucet, where the valve orifice transitions from a fully closed position to a fully open position. In addition to not having an explosive initial release of pressure, such devices make a "swoosh" sound which does not provide an accurate sound simulation.

A common problem with the higher operational pressures is safety factor. A limitation to known pneumatic shooting devices is that their structure does not allow safe operation at the pressures required to propel a large projectile. A further limitation of known pneumatic shooting devices is they are typically limited for use with a single type of projectile, such as a ball.

What is needed in the art is a pneumatic shooting device which is scalable to a large range of operating pressures, which has a minimum of moving parts, which is operable at a relatively high pneumatic pressure, which is capable of safe operation at high pneumatic pressures, which does not reduce the operating pressure due to blowback or other operational deficiencies, which is economical to manufacture, which provides reliable repetitive use, which

requires minimal maintenance, which can be used with a variety of projectiles or projectile material and which provides good sound simulation.

## SUMMARY OF THE INVENTION

The present invention provides a pneumatic shooting device with a scalable action that is operable at a relatively high pressure and over a large pressure range.

The invention comprises, in one form thereof, a pneumatic shooting device, including a barrel and an action having a housing defining a pressure reservoir with a discharge outlet connected to the barrel. A linear bearing body is coupled with the housing. A piston with a discharge end is slidably movable within the linear bearing body to selectively open and close the discharge outlet.

An advantage of the present invention is a pneumatic shooting device which is scalable to a large range of operating pressures.

Another advantage of the present invention is a pneumatic shooting device which has a minimum of moving parts.

Yet another advantage is of the present invention is a pneumatic shooting device which is operable at a relatively high pneumatic pressure.

A further advantage is of the present invention is a pneumatic shooting device which is capable of safe operation at high pneumatic pressures.

A further advantage is of the present invention is a pneumatic shooting device which does not reduce the operating pressure due to blowback or other operational deficiencies.

A further advantage is of the present invention is a pneumatic shooting device which is economical to manufacture.

A further advantage is of the present invention is a pneumatic shooting device which provides reliable repetitive use.

A further advantage is of the present invention is a pneumatic shooting device which requires minimal maintenance.

A further advantage is of the present invention is a pneumatic shooting device which can be used with a variety of projectiles or projectile material.

A further advantage is of the present invention is a pneumatic shooting device which provides good sound simulation.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a partially fragmentary side view of an embodiment of a pneumatic shooting device of the present invention;

Fig. 2 is a schematic view of an embodiment of a pneumatic shooting device of the present invention shown in the ready state;

Fig. 3 is a schematic view of an embodiment of a pneumatic shooting device of the present invention shown in the fire state;

Fig. 4 is a partially cross sectional side view of an embodiment of the action of the present invention taken along section line 4-4 in Fig. 1; and

Fig. 5 is a partially fragmentary side view of another embodiment of a pneumatic shooting device of the present invention.

Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate one preferred embodiment of the invention,

in one form, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

## DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and more particularly to Fig. 1, there is shown a pneumatic shooting device 10 including a barrel 12 and an action 14.

Action 14 includes housing 16 defining a pressure reservoir 18 with a discharge outlet 20 connected to barrel 12. A linear bearing body 22 is coupled with housing 16. Action 14 further includes piston 24 with a discharge end 26. Piston 24 is slidably movable within linear bearing body 22 to selectively open and close discharge outlet 20.

Linear bearing body 22 can be at least partially defined by and/or attached to pressure reservoir 18.

Piston 24 can include an actuating end 28, and housing 16 can include an actuating reservoir 30, actuating end 28 is at least partially located within actuating reservoir 30. Seal 31, such as an O-ring, pneumatically separates pressure reservoir 18 and actuating reservoir 30. A pressurized gas source 32 is pneumatically connected to both pressure reservoir 18 and actuating reservoir 30. Pressurized gas source 32 can be a tube leading to a pressure canister, as shown, or the canister alone. Trigger 34, actuated by a shooter, actuates firing valve 36. Pressure reservoir 18 is pressurized by pressurized gas source 32 through regulator 60. Resilient member 36 biases discharge end 26 of piston 24 against discharge outlet 20 to allow the pressurization of pressure reservoir 18. When trigger 34 is actuated to close firing valve 36 (Fig. 3) actuating reservoir 30 is pressurized to force actuating end 28 to oppose resilient member 38 thereby opening discharge outlet 20 and releasing the pressure 84 in pressure reservoir 18 through discharge outlet 20 and into barrel 12 to propel projectile 40 through and out of barrel 12.

A supply fitting 42 is pneumatically connected to pressure reservoir 18. An actuator fitting 44 is pneumatically connected to actuating reservoir 30. A slip ring 46 can be connected to both supply fitting 42 and actuator fitting 44 to allow for a proper positioning of supply fitting 42 and actuator fitting 44.

An end cap 48 is pneumatically connected to actuating reservoir 30 and end cap 48 has an exhaust vent 52 connected to ambient to discharge actuating reservoir 30 or alternatively, housing 16 can include exhaust vent 53. A trigger safety 50 is connected to trigger 34.

Discharge end 26 includes a taper 54 to improve the explosive release of the pressurized gas into discharge outlet 20 and barrel 12. A radial seal 56 provides a pneumatic seal when piston 24 closes discharge outlet 20. Alternatively, barrel interface 58 of pressure reservoir 18 can include a face seal 57. For a face seal embodiment, discharge end 26 of piston 24 fits over discharge outlet 20, instead of in discharge outlet 20, and contacts face seal 57. Both of the radial seal and the face seal can be an O-ring, for example.

A regulator 60 is pneumatically connected to pressurized gas source 32. A supply tubing 62 connects regulator 60 to pressure reservoir 18. Similarly, actuator tubing 63 connects firing valve 36 to actuating reservoir 30. Tubing 62 has a burst pressure and pressure reservoir 18 has a pressure rating, a ratio of the burst pressure to the pressure rating is no more than 0.5 which provides for the tubing to fail well prior to a potential failure of pressure reservoir 18. In the unlikely event that tubing 62 fails (regulator 60 regulates the pressure in tubing 62 below its burst pressure), tubing 62 will harmlessly burst within tubing housing 64 and discharge pressure reservoir 18 well before the pressure rating of pressure reservoir 18 is reached. As a further safety feature, pressure reservoir 18 has both a pressure rating and an operating pressure, a ratio of the operating pressure to the pressure rating is no more than 0.5. Therefor regulator 60 regulates at a pressure well below the pressure rating of pressure reservoir 18.

A pressure relief valve 66 is located between pressure reservoir 18 and ambient to keep the operational pressure of pressure reservoir 18 well below its pressure rating thus providing further safety redundancy. A breech 68 is associated with barrel 12 and pneumatic shooting device 10 is loaded with projectile 70 at breech 68. As shown in dashed lines in Fig. 1, barrel 12 is disconnected from discharge outlet 20 during loading therefore projectile 70 cannot be fired from barrel 12 during loading. A trigger lock out (not shown) can be provided when the barrel is in the open position to provide yet further safety redundancy.

For example, pressure reservoir 18 can have a pressure rating of 500 psi (pounds per square inch) and pressure reservoir 18 is operated at a pressure of no more than 200 psi, well within the pressure rating of pressure reservoir 18.

Discharge outlet 20 has a discharge outlet diameter 72. Barrel 12 has a barrel diameter 74. A ratio of discharge outlet diameter 72 to barrel diameter 74 is greater than 0.1. This relatively large ratio provides for an explosive release of high pressure, accompanied by a explosive sound, which is both capable of propelling larger projectiles and providing realistic weapon sound. Discharge outlet 20 can be an abrupt pneumatic orifice 76 which can further enhance the explosive sound at firing.

As shown in Fig. 5, pneumatic shooting device 80 can be a grenade launcher demonstrating the scalable nature of action 14. The pneumatic shooting device of the present invention can be a bazooka, a grenade launcher, a mortar, a rocket launcher, a cannon, a rocket propelled grenade launcher, a missile launcher, a landmine and/ or a gun further demonstrating the scalable nature of action 14.

Alternatively, barrel 12 and housing 16 are monolithic or separate.

Although piston 24 is shown as being pneumatically actuated, piston 24 can be at least pneumatically actuated, electrically actuated, magnetically actuated, electro-magnetically

actuated and/or chemically actuated. For example, actuating end 26 of piston 24 can be magnetized and actuating reservoir 30 can include an electrical coil. The trigger when actuated electrifies the coil which provides a force on the actuating end of the piston thereby firing the device. An example of chemical actuation is the trigger impacting a pyrotechnic firing cap, firing the cap creating a firing pressure, which firing pressure actuates the piston.

Alternatively, trigger 34 and firing valve 36 can be replaced by a solenoid valve (not shown) for remote operation of the pneumatic shooting device, as may be the case in a multi-barreled arrangement, or when the pneumatic shooting device is used on or in conjunction with a vehicle, which may a ground, underground, air, sea, undersea or space vehicle. For example, the multiple barreled arrangement is conceived as multiple pneumatic shooting devices in a variety of geometric patterns depending on the design and application of the multiple barreled arrangement. Different types of pneumatic shooting devices, such as a bazooka and a grenade launcher, can also be combined in a multiple barreled arrangement. Each supply line for one of multiple of the pneumatic shooting devices of the multiple barreled arrangement can be connected to a regulator output of a pressurized gas source. Each of the multiple pneumatic shooting devices can have separate triggers and firing valves, or alternatively, the triggers and valves can be replaced by a single or multiple solenoid valves, for example, for simultaneous, sequential, or other patterned firing of the multiple pneumatic shooting devices.

The pneumatic shooting device of the present invention can be used with a variety of projectiles. For example, projectile 40 is shown as a ball, projectile 70 is shown as a rocket or bazooka round and projectile 82 is shown as a grenade. The pneumatic shooting device of the present invention can use a projectile which is a fluid, a powder, a fragment, a rocket, a confetti, a shot, a bazooka round, a mortar round, a missile, a ball, a bullet, a grenade and/or a cannon shell.

In use, pneumatic shooting device 10 is connected to pressurized gas source 32 which pressurizes pressure reservoir 18 of action 14. A projectile is loaded into barrel 12 of pneumatic shooting device 10. Trigger 34 of pneumatic shooting device 10 is actuated. Piston 24 is moved within linear bearing body 22 of action 14. Piston 24 is released from discharge outlet 20 in housing 16. A volume of a pressurized gas 84 is expelled through barrel 12 thereby ejecting a projectile.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.